Cochrane Library

Cochrane Database of Systematic Reviews

Supportive devices for preventing and treating subluxation of the shoulder after stroke (Review)

Ada L, Foongchomcheay A, Canning CG

Ada L, Foongchomcheay A, Canning CG.
Supportive devices for preventing and treating subluxation of the shoulder after stroke.
Cochrane Database of Systematic Reviews 2005, Issue 1. Art. No.: CD003863.
DOI: 10.1002/14651858.CD003863.pub2.

www.cochranelibrary.com

WILEY

TABLE OF CONTENTS

[Intervention Review]

Supportive devices for preventing and treating subluxation of the shoulder after stroke

Louise Ada[1], Anchalee Foongchomcheay[1], Colleen G Canning[1]

[1]School of Physiotherapy, University of Sydney, Lidcombe, Australia

Contact address: Louise Ada, School of Physiotherapy, University of Sydney, University of Sydney, Cumberland Campus, PO Box 170, Lidcombe, New South Wales, 1825, Australia. l.ada@fhs.usyd.edu.au.

Editorial group: Cochrane Stroke Group
Publication status and date: Edited (no change to conclusions), published in Issue 1, 2010.

Citation: Ada L, Foongchomcheay A, Canning CG. Supportive devices for preventing and treating subluxation of the shoulder after stroke. *Cochrane Database of Systematic Reviews* 2005, Issue 1. Art. No.: CD003863. DOI: 10.1002/14651858.CD003863.pub2.

ABSTRACT

Background

Supportive devices such as slings, wheelchair attachments and orthoses have been used to treat subluxation of the shoulder after stroke.

Objectives

To investigate the effect of supportive devices in preventing subluxation, re-positioning the head of humerus in the glenoid fossa, decreasing pain, increasing function and adversely increasing contracture in the shoulder after stroke.

Search methods

We searched the Cochrane Stroke Group Trials Register (last searched on 22 March 2004). In addition, we searched the Cochrane Central Register of Controlled Trials (CENTRAL) (*The Cochrane Library*, Issue 1, 2004), MEDLINE (1966 to March 2004), CINAHL (1982 to March 2004), EMBASE (1974 to March 2004), AMED (1985 to March 2004) and the Physiotherapy Evidence Database (PEDro, March 2004). We also handsearched conference proceedings and contacted authors for additional information.

Selection criteria

Studies were included if they were: randomised, quasi-randomised or controlled trials; participants had a stroke; intervention was supportive devices; and subluxation, pain, function or contracture were measured.

Data collection and analysis

Two independent reviewers examined the identified studies which were assessed for methodological quality and analysed as (1) supportive devices versus no supportive devices or (2) two supportive devices.

Main results

Four trials (one on slings, three on strapping - 142 participants) met the inclusion criteria. One trial testing a hemisling versus no device reported that no participants had subluxation greater than 10 mm, the same number had lost more than 30 degrees of shoulder external rotation (Peto odds ratio (OR) 1.00, 95% confidence interval (CI) 0.1 to 9.3), and more participants in the hemisling group had pain (Peto OR 8.7, 95% CI 1.1 to 67.1). The other three showed that strapping was effective in delaying the onset of pain (weighted mean difference (WMD) 14 days, 95% CI 9.7 to 17.8), but was ineffective in reducing pain severity (WMD -0.7 cm on a visual analogue scale, 95% CI -2.0 to 0.7), increasing upper limb function (WMD 0.8, 95% CI -1.5 to 3.1) or affecting the degree of contracture (WMD -1.4 degrees, 95% CI -10.9 to 8.1) at the shoulder.

Authors' conclusions

There is insufficient evidence to conclude whether slings and wheelchair attachments prevent subluxation, decrease pain, increase function or adversely increase contracture in the shoulder after stroke. There is some evidence that strapping the shoulder delays the onset of pain but does not decrease it, nor does it increase function or adversely increase contracture.

PLAIN LANGUAGE SUMMARY

Supportive devices for preventing and treating subluxation of the shoulder after stroke

There is insufficient evidence to conclude that supportive devices are effective in the prevention and treatment of subluxation of the shoulder after stroke. Shoulder subluxation is one of the most common secondary musculoskeletal problems after stroke which can cause pain and hinder the recovery of upper limb function. Supportive devices have traditionally been applied to treat shoulder subluxation. This review of four trials found insufficient evidence to conclude whether supportive devices prevent subluxation or not and found no evidence to conclude whether supportive devices can reposition the head of humerus in the glenoid fossa of an already subluxed shoulder.

BACKGROUND

Inferior glenohumeral joint displacement, referred to as shoulder subluxation, is one of the most common musculoskeletal problems of the upper limb in individuals after stroke. Without muscle activity, the gravitational pull on the humerus causes stretching of the capsule of the shoulder joint resulting in shoulder subluxation (Moskowitz 1969). Proportional frequency of shoulder subluxation appears to be related to the recovery of muscles of the upper limb, i.e., the frequency of subluxation is related to the degree of the paralysis in the upper limb. For example, Najenson et al (Najenson 1971) reported an 81% proportional frequency, Smith et al (Smith 1982) reported a 60% proportional frequency while Miglietta et al (Miglietta 1959) reported a 56% proportional frequency in stroke patients who had no muscle activity of the upper arm. The proportional frequency was lower (40%) in stroke patients who had some activity in their upper arm (Linn 1999). Similarly, Chaco and Wolf (Chaco 1971) and Hurd et al (Hurd 1974) reported only a 15% and 7% proportional frequency in stroke patients who had activity of the upper arm muscles within one month.

Shoulder subluxation is considered a problem because it is believed to cause shoulder pain and hinder the recovery of upper limb function. It has been suggested that subluxation causes shoulder pain by overstretching the soft tissues (such as the shoulder capsule and muscles) surrounding the shoulder (Cailliet 1980; Chino 1981; Shai 1984). However, most studies report no significant correlation between subluxation and pain (Bohannon 1990; van Langenberghe 1988; Zorowitz 1996) indicating that subluxation is only one of several possible causes of shoulder pain following stroke. In contrast, there is more consistent evidence indicating that subluxation is associated with poor upper limb function (Hanger 2000) and reflex sympathetic dystrophy (a syndrome which presents with pain and tenderness of the affected part, associated with vasomotor instability or skin changes) (Dursun 2000). Therefore, prevention of shoulder subluxation should be an important focus of upper limb rehabilitation after stroke.

Since the 1950s, supportive devices such as slings, wheelchair attachments and external shoulder orthoses have been applied to counteract the downward pull of gravity on the humerus in an effort to treat shoulder subluxation. However, the effect of these supportive devices on subluxation, pain, function and adversely on contracture has not been systematically investigated.

OBJECTIVES

The main objectives of this systematic review were to investigate the following.
(1) The effect of supportive devices (slings, attachments to wheelchairs/chairs and external shoulder orthoses) in preventing subluxation of the shoulder after stroke.
(2) The effect of supportive devices in re-positioning the head of the humerus in the glenoid fossa in a shoulder that is already subluxed after stroke.
(3) The effect of supportive devices in preventing pain and improving function in the shoulder after stroke.
(4) The adverse effect of supportive devices in increasing contracture in the shoulder after stroke.

METHODS

Criteria for considering studies for this review

Types of studies

Truly randomised, quasi-randomised, and controlled trials investigating the effect of two supportive devices or supportive devices versus no supportive devices were included in the review. Concealment, blinding and dropouts were noted for all studies but were not used to determine inclusion.

Types of participants

Studies which included patients of any gender and any age with a clinical diagnosis of stroke were included. Although it was envisaged that some trials would include participants with other types of upper motor neuron lesions, no mixed trials were identified. If trials of mixed participants had been identified, we would have attempted to obtain data for the stroke subgroup.

Types of interventions

Trials that evaluated the effect of any supportive device were included. Supportive devices were defined as any device designed to hold the head of humerus in the glenoid fossa by supporting the weight of the arm. It was planned to divide supportive devices into three categories: slings (such as Bobath sling or triangular sling), wheelchair attachments (such as lap-trays or arm troughs), and external shoulder orthoses (such as strapping or the Functional Shoulder Orthosis). However, there were insufficient trials for this to be necessary.

Types of outcome measures

The primary outcome of interest was subluxation. Our intention was to analyse continuous variables (i.e., mm of subluxation measured from X-ray) where possible, or dichotomous variables (i.e., presence or absence of subluxation). There was one trial examining the prevention of subluxation (Hurd 1974) in terms of the presence or absence of subluxation.

The other outcomes of interest were pain, function and contracture. For pain, our intention was to analyse continuous variables (i.e., cm of pain on a visual analogue scale) where possible, or dichotomous variables (i.e., presence or absence of pain). There was one trial which reported pain on a visual analogue scale (Hanger 2000). However, two other trials reported pain as number of pain free days after introduction of supportive devices (Ancliffe 1992; Griffin 2003) and these were pooled. Another trial (Hurd 1974) reported pain as presence or absence of pain. For function, our intention was to analyse continuous variables (i.e., normalised functional scales of upper limb activities). There was one trial (Hanger 2000) which reported function using the upper limb items of the Motor Assessment Scale (Carr 1985). For contracture, our intention was to analyse continuous variables (i.e., degrees of shoulder range of motion) wherever possible, or dichotomous variables (i.e., presence or absence of contracture). There was one trial (Hanger 2000) which reported contracture as degrees of shoulder external rotation and one trial (Hurd 1974) which reported the presence of contracture (i.e., loss of equal to or greater than 30 degrees of range of motion).

Search methods for identification of studies

See: 'Specialized register' section in Cochrane Stroke Group

We searched the Cochrane Stroke Group Trials Register, which was last searched by the Review Group Co-ordinator on 22 March 2004. In addition, we searched the Cochrane Central Register of Controlled Trials (CENTRAL) (*The Cochrane Library*, Issue 1, 2004) (Appendix 1), MEDLINE (1966 to March 2004) (Appendix 1), CINAHL (1982 to March 2004) (Appendix 2), AMED (1985 to March 2004) (Appendix 3), EMBASE (1974 to March 2004) (Appendix 4), and the Physiotherapy Evidence Database (PEDro: www.pedro.fhs.usyd.edu.au) (March 2004).

The database searches were supplemented by handsearching of the following conference proceedings.
(1) International Congress of the World Confederation for Physical Therapy (World Confederation of Physical Therapy 1991 to 2003)
(2) International Physiotherapy Congress (Australian Physiotherapy Association 1980 to 2002)
(3) Australian Physiotherapy Conferences (APA 1980 to 2000)
(4) Australian Neurological Physiotherapy Conference (APA 2003)

Data collection and analysis

Identification of relevant studies

One reviewer (AF) read the titles of the identified references and eliminated obviously irrelevant studies based on titles and, where available, abstracts. Two reviewers (AF and CC, physiotherapists with a background in neurological rehabilitation) independently examined potentially relevant studies using predetermined criteria. These criteria were: the study was a randomised, quasi-randomised or controlled trial; participants were individuals who had had a stroke; interventions were a sling or a wheelchair attachment or an external shoulder orthosis; and subluxation or pain or function or contracture was measured as an outcome. Studies were ranked as excluded, or included or uncertain using a checklist. Disagreement was resolved by discussion between the reviewers (AF and CC). Trials that included participants that were less than two months from time of onset of stroke were investigated for the effect of supportive devices in preventing subluxation and pain, improving function and adversely increasing contracture in the shoulder. Trials that included participants with an already subluxed shoulder were planned to be investigated for the effect of supportive devices in repositioning the head of the humerus in the glenoid fossa, however, there were no trials identified in this category. There were no potentially-relevant, non-English trials requiring translation.

Assessment of methodological quality

The reviewers (AF and CC) scored the methodological quality of the included studies using the 11-item PEDro scale (Moseley 2002), which is based on the Delphi List (Verhagen 1998) and available at The Physiotherapy Evidence Database (PEDro) (http://www.pedro.fhs.usyd.edu.au/scale_item.html). Items are: specification of eligibility criteria; random allocation to groups; concealed allocation; groups similar at baseline; blinding of participants, therapists and assessors; at least one outcome measurement obtained from more than 85% of participants initially allocated to groups; reporting of between-group statistical comparisons; reporting of point measures and measures of variability. Disagreement was resolved by discussion between the reviewers.

Data extraction

Two reviewers (AF and CC) extracted descriptions of the studies including methods, inclusion criteria, participants' characteristics, description of the supportive devices, duration of intervention, and outcome measures reported. The number of participants as well as the means and standard deviations of outcome measures were extracted from each of the studies and recorded for analysis. The authors of the trials were contacted to provide clarification and/or missing data where possible.

Comparisons

Our intention was to compare (1) supportive devices versus no supportive devices or (2) two supportive devices. However, there were no trials identified in the latter category. Therefore, trials of supportive devices versus no supportive devices were analysed for the following outcomes.
(1) Preventing subluxation
(2) Re-positioning the head of humerus
(3) Decreasing pain
(4) Increasing function
(5) Increasing contracture
However, there were no trials identified which investigated the outcome of repositioning the head of humerus.

Statistical analysis

If there were at least two studies that used the same outcome measurement, data was pooled. First, a test for heterogeneity and normality of continuous data was performed. Where there was homogeneity and normality, the effect sizes were reported as weighted mean differences (WMD) and 95% confidence intervals (CI), and a fixed-effect model was used. Where there was significant heterogeneity ($p < 0.1$ using the Q-test or chi-square test) and lack of normality, the effect size were reported as standardised mean differences (SMD and 95% CI) and a random-effects model was used. Peto odds ratios (Peto OR) and 95% CI were calculated for dichotomous data. All analyses were intention to treat wherever possible.

R E S U L T S

Description of studies

Identification of relevant trials

Of the 270 studies retrieved from electronic database and hand searching, 244 obviously irrelevant studies were eliminated, leaving 26 potentially relevant studies. Examination of the reference lists of these potential studies and handsearching of conference proceedings added a further two studies making a total of 28 potentially relevant studies. Two independent reviewers (AF and CC) identified four studies for inclusion. Two reviewers (LA and CC) classified these four studies into the previously identified categories. Descriptions of the included studies can be found in the 'Characteristics of included studies' table and in Additional Table 1 (Methodological Quality of Included Studies).

All four studies were classified as trials of supportive devices versus no supportive devices. One study (14 participants) examined the effect of supportive devices in preventing subluxation (Hurd 1974).

Four studies (142 participants) examined the effect of supportive devices in decreasing pain (Ancliffe 1992; Griffin 2003; Hanger 2000; Hurd 1974). One study (98 participants) examined the effect of supportive devices in increasing function (Hanger 2000). Two studies (112 participants) examined the effect of supportive devices in adversely increasing contracture (Hanger 2000; Hurd 1974).

No studies examining the effect of supportive devices on repositioning the head of humerus in the glenoid fossa were identified.

Included studies comparing supportive devices with no supportive devices

Ancliffe 1992

This trial used alternate allocation to examine the effect of shoulder strapping on pain in eight participants after acute stroke (see 'Characteristics of included studies' for details) (Ancliffe 1992).

Griffin 2003

This trial used concealed random allocation to examine the effect of shoulder strapping on pain in 22 participants after acute stroke (see 'Characteristics of included studies' for details) (Griffin 2003).

Hanger 2000

This trial used concealed random allocation to examine the effect of shoulder strapping on pain, function and contracture in 98 participants after acute stroke (see 'Characteristics of included studies' for details) (Hanger 2000).

Hurd 1974

This trial used alternate allocation to examine the effect of a hemisling on subluxation, pain and contracture in 14 participants after acute stroke (see 'Characteristics of included studies' for details) (Hurd 1974).

Risk of bias in included studies

Details of the methodological quality are reported in the additional table (Table 1 'Methodological Quality of Included Studies'). For studies included in this review the maximum total PEDro score possible is 8 out of 10 since it is not possible to blind the participants or the physiotherapists to the intervention. The trials were variable in quality with two scoring highly (Griffin 2003; Hanger 2000) and two scoring poorly (Ancliffe 1992; Hurd 1974).

Effects of interventions

Comparison 01: Supportive devices versus no supportive devices

Preventing subluxation

There was one trial examining the effect of a hemisling in preventing subluxation (Hurd 1974. Hurd reports that only one participant (from the group that wore the hemisling) developed subluxation greater than 10 mm at the final follow up (five months) implying that no participants had greater than 10 mm of subluxation at initial follow up (four weeks).

Repositioning the head of humerus

There were no trials investigating the effect of supportive devices in repositioning the head of humerus in the glenoid fossa in a shoulder that is already subluxed.

Decreasing pain

There was one trial examining the effect of a hemisling in decreasing pain (Hurd 1974) where pain was reported as the number of participants who had nil, little or severe pain. There were significantly less participants who had pain at initial follow up (four weeks) in the no hemisling group (Peto OR 8.7, 95% CI 1.1 to 67.1, $p = 0.04$) (See Figure 01 Comparison 01 Outcome 01).

There were two trials examining the effect of strapping in decreasing pain (Ancliffe 1992; Griffin 2003) where pain was reported as the number of pain free days after admission to the study. Shoulder strapping significantly delayed the onset of shoulder pain by 14 days (WMD 14 days, 95% CI 9.7 to 17.8, fixed effect, $p < 0.001$) (See Figure 01 Comparison 01 Outcome 02). There was one trial examining the effect of strapping in decreasing pain (Hanger 2000) where pain severity was reported over the previous 24 hours on a visual analogue scale at six weeks after admission to the study. There was no difference in pain between the strapping group versus the no strapping group (WMD -0.7 cm, 95% CI -2.0 to 0.7, fixed effect, $p = 0.34$) (See Figure 01 Comparison 01 Outcome 03).

Increasing function

There was one trial examining the effect of strapping in increasing function (Hanger 2000) where function was reported as the summation of items 6, 7 and 8 of the Motor Assessment Scale. There was no difference in function between the strapping group versus the no strapping group (WMD 0.8, 95% CI -1.5 to 3.1, fixed effect, $p = 0.48$) (See Figure 01 Comparison 01 Outcome 04).

Increasing contracture

There was one trial examining the adverse effect of a hemisling in increasing contracture (Hurd 1974) where contracture was reported as the number of participants who had more than 30 degrees loss of shoulder external rotation. There was no difference in contracture between the hemisling group versus the no hemisling group (Peto OR 1.00, 95% CI 0.1 to 9.3, $p = 1.00$) (See Figure 01 Comparison 01 Outcome 05).

There was one trial examining the adverse effect of strapping in increasing contracture (Hanger 2000) where contracture was reported as range of shoulder external rotation at six weeks after admission to the study. There was no difference in contracture between the strapping group versus the no strapping group (WMD -1.4 degrees, 95% CI -10.9 to 8.1, fixed effect, $p = 0.77$) (See Figure 01 Comparison 01 Outcome 06).

Comparison 02: Two supportive devices

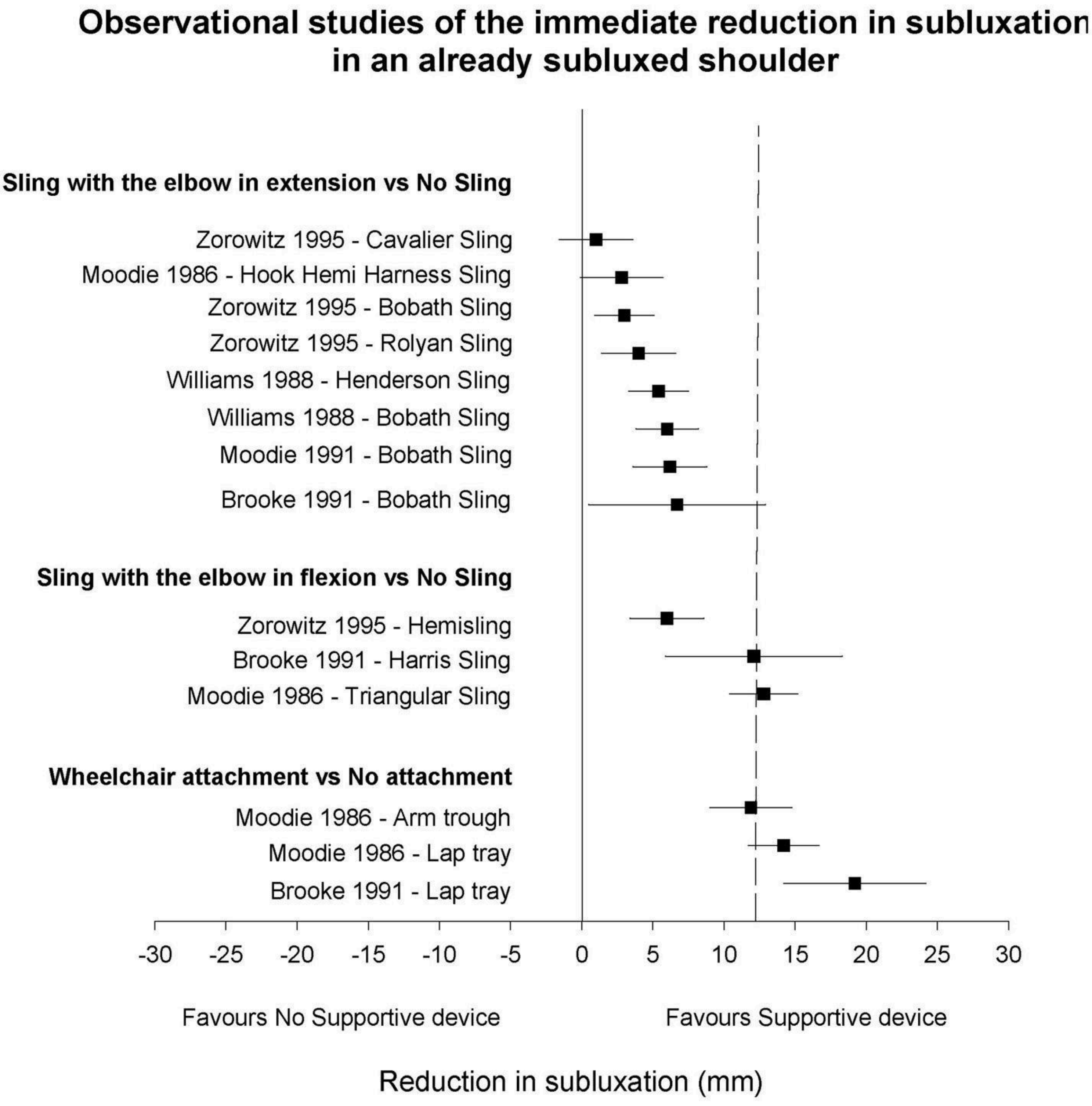
There were no studies comparing two different supportive devices.

DISCUSSION

Musculoskeletal impairments of the shoulder, such as subluxation, pain and contracture, are common secondary problems after stroke. We are confident that our detailed search strategy of the electronic databases combined with hand searching of conference proceedings and references lists of published studies identified all relevant studies of supportive devices for prevention of these problems. It is therefore surprising to find only one clinical trial examining the effect of a sling (a routine intervention for the last 50 years) in preventing subluxation and pain as well as examining any adverse effect of increasing contracture. Furthermore, this trial was of disappointingly low quality. There were two high quality trials and one low quality trial examining the effect of strapping (a recently developed intervention) in preventing pain. However, these trials did not examine prevention of subluxation and only one examined prevention of contracture and improvement in function.

The only clinical trial examining the effect of a sling - a hemisling - reported no effect of wearing the sling for two to three weeks on subluxation or contracture. This is not surprising, since subluxation was considered to be clinically significant only when greater than 10 mm and contracture only when greater than 30 degrees. The development of these large amounts of subluxation and contracture within a month after stroke seems unlikely. Moreover, quite small amounts of subluxation cause malalignment of the humeral head and the glenoid fossa (Ada 2002; van Langenberghe 1988) which will interfere with function. Furthermore, if numbers of patients with clinically significant impairments are reported in future studies, then the period of intervention should be taken into account. For example, preventing 5 mm of subluxation and 15 degrees of loss of shoulder external rotation with a four-week intervention would seem useful based on the amount of subluxation (Ada 2004; Linn 1999) and contracture (Ada 2004; Hanger 2000) developed in the control groups of previous clinical trials. There have been a number of observational studies which have examined the immediate effect of supportive devices in reducing subluxation in a shoulder that is already subluxed, i.e., subluxation of the shoulder was compared with a supportive device on and off (Brooke 1991; Moodie 1986; Williams 1988; Zorowitz 1995). Furthermore, although the order of measurement of subluxation (device on or off) was not randomised, in two of the studies (Williams 1988; Zorowitz 1995) the radiographers were blinded to device on or off and in the other two studies (Brooke 1991; Moodie 1986), the radiographers were not familiar with the supportive devices. Given the absence of prospective randomised controlled trials, these studies are worth examining in order to ascertain which devices are likely to have the potential to prevent subluxation. The four devices that produce an immediate reduction in subluxation are the lap tray, the arm trough, the triangular sling and the Harris sling (Figure 1) and it is, therefore, the ability of these devices to prevent subluxation that should be tested.

Figure 1. Means and 95% CIs for the immediate reduction in subluxation (mm) with the use of supportive devices in an already subluxed shoulder. The vertical dotted line represents the average subluxation before applying supportive devices (calculated across the 4 studies)



Three clinical trials, two high quality and one low quality, examined the effect of strapping the shoulder. The application of strapping was found to be effective in delaying the onset of pain by 14 days based on the pooled analysis of one high and one low quality trial. However, the result from another high quality trial showed no difference in pain between strapping and no strapping after six weeks of intervention. There were slight differences in strapping technique between the studies but the trial with the strapping that appeared the most supportive (Hanger 2000) was the one which found no effect. It therefore seems reasonable to conclude that strapping is effective in delaying the onset of shoulder pain in the short term, but not in preventing pain in the longer term. Neither was strapping found to have any greater adverse effect in increasing contracture with loss of shoulder external rotation in both groups reaching nearly 30 degrees in two months. In addition, strapping did not increase function.

AUTHORS' CONCLUSIONS

Implications for practice

Given that there is insufficient evidence from randomised controlled trials to conclude whether supportive devices are effective in preventing subluxation of the shoulder after stroke, at present, clinicians have to use other forms of evidence. In addition, since strapping the shoulder appears only to be effective in delaying the onset of, but not preventing pain in the shoulder, and it has no effect on contracture or function, at this stage it is not recommended.

Implications for research

We suggest that there is a need for randomised controlled trials to evaluate the efficacy of supportive devices in preventing subluxation and pain, in increasing arm function, and evaluating any adverse effect of increasing contracture early after stroke. Supportive devices should be applied to these individuals early, i.e., as soon as they are allowed into the upright position, and continued for a period of time long enough for an effect to be detected, i.e., four to six weeks. Outcome measures should include subluxation of the shoulder (mean and standard deviation (SD) in mm as well as number of participants with more than 5 mm of subluxation), pain in the shoulder (mean and SD on a visual analogue scale), arm function and contracture of the shoulder (mean and SD in degrees of shoulder external rotation as well as number of participants with more than 15 degrees loss of shoulder external rotation).

ACKNOWLEDGEMENTS

The authors would like to thank Carl Hanger, Jacqueline Ancliffe, Julie Bernhardt and Richard Zorowitz for providing us with information about their studies.

REFERENCES

References to studies included in this review

Ancliffe 1992 *{published data only}*

Ancliffe J. Strapping the shoulder in patients following a cerebrovascular accident (CVA): a pilot study. *Australian Journal of Physiotherapy* 1992;**38**:37-41.

Griffin 2003 *{unpublished data only}*

Griffin AL, Bernhardt J. Strapping of the hemiplegic shoulder prevents development of shoulder pain during rehabilitation. 1st Neruological Physiotherapy Conference of the National Neurology Group of the Australian Physiotherapy Association. 27-29 November 2003:Sydney, Australia.

Hanger 2000 *{published and unpublished data}*

Hanger HC, Whitewood P, Brown G, Ball MC, Harper J, Cox R, Sainsbury R. A randomized controlled trial of strapping to prevent post-stroke shoulder pain. *Clinical Rehabilitation* 2000;**14**:370-80.

Hurd 1974 *{published data only}*

Hurd MM, Farrell KH, Waylonis GW. Shoulder sling for hemiplegia: friend or foe?. *Archives of Physical Medicine & Rehabilitation* 1974;**55**:519-22.

References to studies excluded from this review

Brooke 1991 *{published data only}*

Brooke MM, de Lateur BJ, Diana-Rigby GC, Questad KA. Shoulder subluxation in hemiplegia: effects of three different supports. *Archives of Physical Medicine & Rehabilitation* 1991;**72**:582-6.

Brudny 1985 *{published data only}*

Brudny J. Functional impact of shoulder taping in the hemiplegic upper extremity. *Orthotics and Prosthetics* 1985;**39**:14-20.

Cool 1989 *{published data only}*

Cool JC. Biomechanics of orthoses for the subluxed shoulder. *Prosthetics & Orthotics International* 1989;**13**:90-6.

Daviet 2002 *{published data only}*

Daviet JC, Preux PM, Salle JY, Lebreton F, Munoz M, Dudognon P, Pelissier J, Perrigot M. Clinical factors in the prognosis of complex regional pain syndrome type I after stroke: a prospective study. *American Journal of Physical Medicine & Rehabilitation* 2002;**81**:34-9.

Egan 1990 *{published data only}*

Egan JM. An aid for the management of shoulder pain in hemiplegia. *British Journal of Occupational Therapy* 1990;**53**:362-4.

Enstrom 1980 *{published data only}*

Enstrom J, Davies J. Lapboard modification to help support a flaccid upper extremity. *Physical Therapy* 1980;**6**:795-6.

Ferreri 1974 *{published data only}*

Ferreri J, Tumminelli J. A swivel cockup splint-type armtrough. *American Journal of Occupational Therapy* 1974;**28**:359.

Gracies 2000 *{published data only}*

Gracies JM, Marosszeky JE, Renton R, Sandanam J, Gandevia SC, Burke D. Short-term effects of dynamic lycra splints on upper limb in hemiplegic patients. *Archives of Physical Medicine & Rehabilitation* 2000;**81**:1547-55.

Krempen 1977 *{published data only}*

Krempen JF, Silver RA, Hadley J, Rivera V. The use of the Varney Brace for subluxating shoulders in stroke and upper motor neuron injuries. *Clinical Orthopaedics & Related Research* 1977;**122**:204-6.

Moodie 1986 *{published data only}*

Moodie NB, Brisbin J, Morgan AMG. Subluxation of the glenoidhumeral joint in hemiplegia: evaluation of supportive devices. *Physiotherapy Canada* 1986;**38**:151-7.

Morin 1997 *{published data only}*

Morin L, Bravo G. Strapping the hemiplegic shoulder: a radiographic evaluation of its efficacy to reduce subluxation. *Physiotherapy Canada* 1997;**49**:103-8.

Patterson 1984 *{published data only}*

Patterson JR, Zabransky R, Grabois M, Ferro P. Evaluation of the effectiveness of sling orthoses for the correction of glenohumeral subluxation in the hemiplegic. *Archives of Physical Medicine & Rehabilitation* 1984;**65**:635.

Peters 2003 *{published data only}*

Peters SB, Lee GP. Functional impact of shoulder taping in the hemiplegic upper extremity. *Occupational Therapy in Health Care* 2003;**17**(2):35-46.

Rajaram 1985 *{published data only}*

Rajaram V, Holtz M. Shoulder forearm support for the subluxed shoulder. *Archives of Physical Medicine & Rehabilitation* 1985;**66**:191-2.

Roy 1989 *{published data only}*

Roy CW, Blamire JG. The function shoulder orthosis in hemiplegic shoulder subluxation: a pilot study. *Clinical Rehabilitation* 1989;**3**:107-9.

Sodring 1980 *{published data only}*

Sodring KM. Upper extremity orthoses for stroke patients. *International Journal of Rehabilitation Research* 1980;**3**:33-8.

Spaulding 1999 *{published data only}*

Spaulding SJ. Biomechanical analysis of four supports for the subluxed hemiparetic shoulder. *Canadian Journal of Occupational Therapy* 1999;**66**:169-75.

Sullivan 1989 *{published data only}*

Sullivan BE, Rogers SL. Modified Bobath sling with distal support. *American Journal of Occupational Therapy* 1989;**43**:47-9.

Walker 1983 *{published data only}*

Walker J. Modified strapping of roll sling. *American Journal of Occupational Therapy* 1983;**37**:110-1.

Williams 1988 *{published data only}*

Williams R, Taffs L, Minuk T. Evaluation of two support methods for the subluxated shoulder of hemiplegic patients. *Physical Therapy* 1988;**68**:1209-14.

Zorowitz 1995 *{published data only}*

Idank DM, Zorowitz RD, Ikai T, Hughes MB, Johnston MV. Shoulder subluxation after stroke: a pilot study comparing four slings. *Archives of Physical Medicine and Rehabilitation* 1993;**74**:1235.

* Zorowitz RD, Idank D, Ikai T, Hughes MB, Johnston MV. Shoulder subluxation after stroke: a comparison of four supports. *Archives of Physical Medicine & Rehabilitation* 1995;**76**:763-71. [Idank 1993]

Zorowitz 1996 *{published data only}*

Zorowitz RD, Hughes MB, Idank D, Ikai T, Johnston MV. Shoulder pain and subluxation after stroke: correlation or coincidence?. *American Journal of Occupational Therapy* 1996;**50**:194-201.

Zorowitz 2001 *{published data only}*

Zorowitz RD. Recovery patterns of shoulder subluxation after stroke: a six-month follow-up study. *Topics in Stroke Rehabilitation* 2001;**8**:1-9.

Additional references

Ada 2002

Ada L, Foongchomcheay A. Efficacy of electrical stimulation in preventing or reducing subluxation of the shoulder after stroke: A meta-analysis. *Australian Journal of Physiotherapy* 2002;**48**:257-67.

Ada 2004

Ada L, Goddard E, McCully J, Stavrinos T, Bampton J. 30 minutes of positioning reduces the development of external rotation but not flexion contracture in the shoulder after stroke: a randomised controlled trial. Archives of Physical Medicine & Rehabilitation (in press).

Bohannon 1986

Bohannon R, LeFort A. Hemiplegic shoulder pain measured with the Ritchie Articluar Index. *International Journal Rehabilitation Research* 1986;**9**:379-81.

Bohannon 1990

Bohannon RW, Andrews AW. Shoulder subluxation and pain in stroke patients. *American Journal of Occupational Therapy* 1990;**44**:507-9.

Cailliet 1980

Cailliet R. The shoulder in hemiplegia. Philadephia: FA Davis Company, 1980:89-106.

Carr 1985

Carr JH, Shepherd RB, Nordholm L, Lynne D. Investigation of a new motor assessment scale for stroke patients. *Physical Therapy* 1985;**65**:175-80.

Chaco 1971

Chaco J, Wolf E. Subluxation of the glenohumeral joint in hemiplegia. *American Journal of Physical Medicine* 1971;**50**:139-43.

Chino 1981

Chino N. Electrophysiological investigation on shoulder subluxation in hemiplegics. *Scandinavian Journal of Rehabilitation Medicine* 1981;**13**:17-21.

Dursun 2000

Durson E, Dursun N, Ural CE, Cakci A. Glenohumeral joint subluxation and reflex sympathetic dystrophy in hemiplegic patients. *Archives of Physical Medicine & Rehabilitaiton* 2000;**81**:944-6.

Linn 1999

Linn SL, Granat MH, Lee KR. Prevention of shoulder subluxation after stroke with electrical stimulation. *Stroke* 1999;**30**(5):963-8.

Miglietta 1959

Miglietta O, Lewitan A, Rogoff JB. Subluxation of the shoulder in hemiplegic patients. *New York State Journal of Medicine* 1959;**1**:457-60.

Moseley 2002

Moseley AM, Herbert R, Sherrington C, Maher C. Evidence for physiotherapy practice: A survey of the Physiotherapy Evidence Database (PEDro). *Australian Journal of Physiotherapy* 2002;**48**:43-9.

Moskowitz 1969

Moskowitz H, Goodman CR, Smith E, Balthazar E, Mellins HZ. Hemiplegic shoulder. *New York State Journal of Medicine* 1969;**15**:548-50.

Najenson 1971

Najenson T, Yacubovich E, Pikielni SS. Rotator cuff injury in shoulder joints of hemiplegic patients. *Scandinavian Journal of Rehabilitation Medicine* 1971;**3**:131-7.

PEDro

Centre for Evidence-Based Physiotherapy. The Physiotherapy Evidence Database (PEDro). http://www.pedro.fhs.usyd.edu.au (accessed 21 August 2002).

Shai 1984

Shai G, Ring H, Costeff H, Solzi P. Glenohumeral malalignment in the hemiplegic shoulder: an early radiologic sign. *Scandinavian Journal of Rehabilitation Medicine* 1984;**16**:133-6.

Smith 1982

Smith RG, Cruikshank JG, Dunbar S, Akhtar AJ. Malalignment of the shoulder after stroke. *British Medical Journal Clinical Research Ed* 1982;**284**:1224-6.

van Langenberghe 1988

van Langenberghe HVK, Hogan BM. Degree of pain and grade of subluxation in the painful hemiplegic shoulder. *Scandinavian Journal of Rehabilitation Medicine* 1998;**20**:161-6.

Verhagen 1998

Verhagen AP, de Vet HC, de Bie RA, Kessels AG, Boers M, Bouter LM, Knipschild PG. The Delphi list: a criteria list for quality assessment of randomized clinical trials for conducting systematic reviews developed by Delphi consensus. *Journal of Clinical Epidemiology* 1998;**51**(12):1235-41.

* Indicates the major publication for the study

CHARACTERISTICS OF STUDIES

Characteristics of included studies *[ordered by study ID]*

Ancliffe 1992

Methods	Parallel group, single centre trial Exp: routine management (details not specified) + strapping C: routine management
Participants	Inclusion criteria: no history of shoulder pain, upper arm paralysis Age (mean): Exp/C = 69/74 years Time after stroke: Exp/C = <2/2 days Number of participants: Exp/C = 4/4 Male/Female = 4/4 Right/Left hemiplegia = 1/7 Dropouts: Exp/C = 0/0
Interventions	Strapping: one protecting pad and two strapping tapes were used. First the protecting pad was positioned on the medial surface of the upper arm to protect the axilla and allow for application of the tape. The first strapping tape began at the middle of the clavicle, continued across the deltoid muscle in a diagonal direction, along the pad under the arm. Then, a slight stretch was applied in the direction of the posterior fibres of the deltoid with the tape terminating one quarter of the way along the spine of the scapula. The second strapping tape was applied in the same direction as the first, but 2 cms below. Strapping was left on day and night and changed every three or four days.
Outcomes	Pain: number of pain-free days (<1 Ritchie Articular Index: 0 = patient has no tenderness, 1 = patient complains of pain, 2 = patient complains of pain and winces, 3 = patient complains of pain, winces, and withdraws, Bohannon 1986) after admission to study
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Unclear risk	D - Not used

Griffin 2003

Methods	Parallel group, single centre trial Exp: strapping + routine management (could include task-specific re-education for function, maintenance of ROM, provision of supportive devices for the arm) Placebo: placebo strapping + routine management C: routine management
Participants	Inclusion criteria: within 4 weeks of stroke, no history of shoulder pain, score on Item 6 of the Motor Assessment scale of less than 4, score on Ritchie Articular Index of less than 2.

Griffin 2003 *(Continued)*

	Age (mean): Exp/P/C = 65/62/59 years Time after stroke (mean): Exp/P/C = 10/10/12 days Number of participants: Exp/P/C = 9/10/12 Male/Female = 22/10 Right/Left hemiplegia = 20/12 Dropouts: Exp/P/C = 1/0/0
Interventions	Strapping: one protecting pad and two strapping tapes were used. First the protecting pad was positioned on the medial surface of the upper arm to protect the axilla and allow for application of the tape. The first strapping tape began at the middle of the clavicle, continued across the deltoid muscle in a diagonal direction, along the pad under the arm. Then, a slight stretch was applied in the direction of the posterior fibres of the deltoid with the tape terminating one quarter of the way along the spine of the scapula. The second strapping tape was applied in the same direction as the first, but 2 cms below. Strapping was left on day and night and changed every three or four days.
Outcomes	Pain: number of pain-free days (< 2 on Ritchie Articular Index: 0 = patient has no tenderness, 1 = patient complains of pain, 2 = patient complains of pain and winces, 3 = patient complains of pain, winces, and withdraws, Bohannon 1986) after admission to study.
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Low risk	A - Adequate

Hanger 2000

Methods	Parallel group, single centre trial Exp: strapping + routine management (task-specific re-education for function, positioning, maintenance of ROM, provision of supportive devices for the arm when mobilising) C: routine management
Participants	Inclusion criteria: within 4 weeks of stroke, no previous shoulder surgery precluding external rotation, unable to abduct shoulder to 90 degrees and hold for 2 seconds (upper arm function equivalent to a score of less than 4 on Item 6 of Motor Assessment Scale) Age (mean): Exp/C = 79/78 years Time after stroke (mean): Exp/C = 12/12 days Number of participants: Exp/C = 49/49 Male/Female = 39/59 Right/Left hemiplegia = 51/47 Dropouts: Exp/C = 8/7
Interventions	Strapping: three strapping and three under strapping tapes were used. The arm was supported under the elbow. First two tapes were applied longitudinally using a lifting action. One tape started from the front of the elbow and went up across the top of the shoulder and terminated past the spine of the scapula. The other tape started from the back of the elbow and went up across the top of the shoulder and terminated past the clavicle. These two tapes crossed at the top of the shoulder. The third tape was applied horizontally from the medial third of the clavicle around the surgical neck of the humerus and along the spine of the scapula to its medial third. Strapping was left on day and night and changed every two or three days. Duration of intervention: six weeks.
Outcomes	Pain: pain over previous 24 hours on 10 cm vertical VAS (cm) Contracture: pain free passive shoulder external rotation (degrees) Function: summation of Items 6, 7, 8 (out of 18) of the Motor Assessment Scale (Carr 1985)

Hanger 2000 *(Continued)*

Notes	Data for forest plots taken from unpublished data supplied by the author Note that there are different numbers of participants at the post-intervention measurements due to missing data

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Low risk	A - Adequate

Hurd 1974

Methods	Parallel group, single centre trial Exp: routine management (details not specified) + sling C: routine management
Participants	Inclusion criteria: first stroke, upper arm paralysis, no previous arm, shoulder or neck injury Age (range) = 22 to 87 years Time after stroke: 1 to 2 weeks Number of participants: Exp/C = 7/7 Male/Female = 4/10 Right/Left hemiplegia = unknown Dropouts: Exp/C = 0/0
Interventions	Sling: hemisling. Duration of intervention: 2 to 3 weeks
Outcomes	Subluxation: number of participants with over 10 mm of subluxation Pain: number of participants who rated pain as nil, little or severe Contracture: number of participants who lost equal or greater than 30 degrees of shoulder external rotation
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Unclear risk	D - Not used

C: control
Exp: experimental
P: placebo
ROM: range of motion
VAS: visual analogue scale

Characteristics of excluded studies *[ordered by study ID]*

Study	Reason for exclusion
Brooke 1991	Observational study
Brudny 1985	Case report

Study	Reason for exclusion
Cool 1989	No outcome of interest
Daviet 2002	No outcome of interest
Egan 1990	Descriptive study
Enstrom 1980	Descriptive study
Ferreri 1974	Descriptive study
Gracies 2000	No outcome of interest
Krempen 1977	Observational study
Moodie 1986	Observational study
Morin 1997	No outcome of interest
Patterson 1984	No data available
Peters 2003	Case report
Rajaram 1985	No outcome of interest
Roy 1989	Case report
Sodring 1980	Descriptive study
Spaulding 1999	No outcome of interest
Sullivan 1989	Descriptive study
Walker 1983	Descriptive study
Williams 1988	Observational study
Zorowitz 1995	Observational study
Zorowitz 1996	No outcome of interest
Zorowitz 2001	No outcome of interest

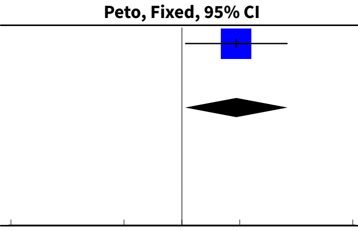
DATA AND ANALYSES

Comparison 1. Supportive devices versus no supportive devices

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Pain (number of participants with pain)	1	14	Peto Odds Ratio (Peto, Fixed, 95% CI)	8.73 [1.14, 67.13]
2 Pain (number of pain free days after admission to study)	2	29	Mean Difference (IV, Fixed, 95% CI)	13.76 [9.68, 17.83]
3 Pain (over previous 24 hours on a 10 cm visual analogue scale post intervention)	1	67	Mean Difference (IV, Fixed, 95% CI)	-0.66 [-2.02, 0.70]
4 Function (summation of Items 6, 7, 8 of the Motor Assessment Scale (score 0-18) post intervention)	1	83	Mean Difference (IV, Fixed, 95% CI)	0.83 [-1.46, 3.12]
5 Contracture (number of participants with > 30° loss of shoulder external rotation)	1	14	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.0 [0.11, 9.34]
6 Contracture (degrees of shoulder external rotation post intervention)	1	81	Mean Difference (IV, Fixed, 95% CI)	-1.40 [-10.90, 8.10]

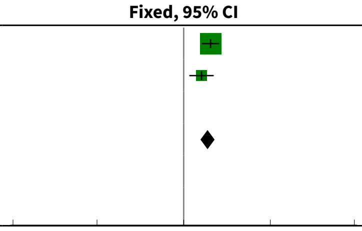
Analysis 1.1. Comparison 1 Supportive devices versus no supportive devices, Outcome 1 Pain (number of participants with pain).

Study or subgroup	Sling n/N	No Sling n/N	Peto Odds Ratio Peto, Fixed, 95% CI	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
Hurd 1974	6/7	2/7		100%	8.73[1.14,67.13]
Total (95% CI)	**7**	**7**		**100%**	**8.73[1.14,67.13]**
Total events: 6 (Sling), 2 (No Sling)					
Heterogeneity: Not applicable					
Test for overall effect: Z=2.08(P=0.04)					



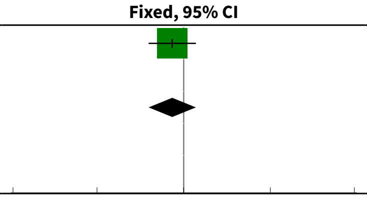
Analysis 1.2. Comparison 1 Supportive devices versus no supportive devices, Outcome 2 Pain (number of pain free days after admission to study).

Study or subgroup	Strapping N	Strapping Mean(SD)	No Strapping N	No Strapping Mean(SD)	Mean Difference Fixed, 95% CI	Weight	Mean Difference Fixed, 95% CI
Ancliffe 1992	4	21 (4.2)	4	5.5 (2.9)		66.46%	15.5[10.5,20.5]
Griffin 2003	9	26.2 (3.9)	12	15.9 (11.6)		33.54%	10.3[3.26,17.34]
Total ***	**13**		**16**			**100%**	**13.76[9.68,17.83]**
Heterogeneity: Tau²=0; Chi²=1.39, df=1(P=0.24); I²=28.2%							
Test for overall effect: Z=6.61(P<0.0001)							



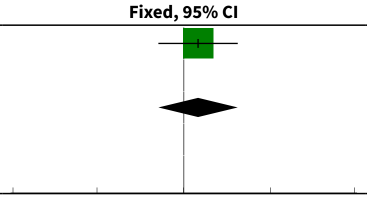
Analysis 1.3. Comparison 1 Supportive devices versus no supportive devices, Outcome 3 Pain (over previous 24 hours on a 10 cm visual analogue scale post intervention).

Study or subgroup	Strapping N	Strapping Mean(SD)	No Strapping N	No Strapping Mean(SD)	Mean Difference Fixed, 95% CI	Weight	Mean Difference Fixed, 95% CI
Hanger 2000	33	1.7 (3)	34	2.4 (2.7)		100%	-0.66[-2.02,0.7]
Total ***	**33**		**34**			**100%**	**-0.66[-2.02,0.7]**
Heterogeneity: Not applicable							
Test for overall effect: Z=0.95(P=0.34)							



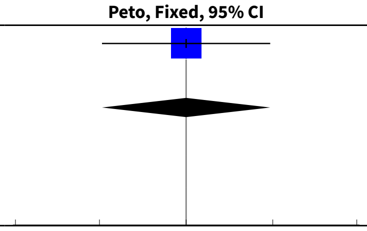
Analysis 1.4. Comparison 1 Supportive devices versus no supportive devices, Outcome 4 Function (summation of Items 6, 7, 8 of the Motor Assessment Scale (score 0-18) post intervention).

Study or subgroup	Strapping N	Strapping Mean(SD)	No Strapping N	No Strapping Mean(SD)	Mean Difference Fixed, 95% CI	Weight	Mean Difference Fixed, 95% CI
Hanger 2000	41	4.6 (5.6)	42	3.8 (5)		100%	0.83[-1.46,3.12]
Total ***	**41**		**42**			**100%**	**0.83[-1.46,3.12]**
Heterogeneity: Not applicable							
Test for overall effect: Z=0.71(P=0.48)							



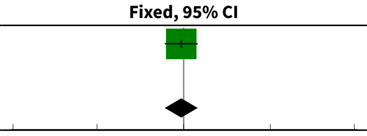
Analysis 1.5. Comparison 1 Supportive devices versus no supportive devices, Outcome 5 Contracture (number of participants with > 30° loss of shoulder external rotation).

Study or subgroup	Sling n/N	No Sling n/N	Peto Odds Ratio Peto, Fixed, 95% CI	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
Hurd 1974	2/7	2/7		100%	1[0.11,9.34]
Total (95% CI)	**7**	**7**		**100%**	**1[0.11,9.34]**
Total events: 2 (Sling), 2 (No Sling)					
Heterogeneity: Not applicable					
Test for overall effect: Not applicable					



Analysis 1.6. Comparison 1 Supportive devices versus no supportive devices, Outcome 6 Contracture (degrees of shoulder external rotation post intervention).

Study or subgroup	Strapping N	Strapping Mean(SD)	No Strapping N	No Strapping Mean(SD)	Mean Difference Fixed, 95% CI	Weight	Mean Difference Fixed, 95% CI
Hanger 2000	39	41.8 (21.1)	42	43.2 (22.5)		100%	-1.4[-10.9,8.1]
Total ***	**39**		**42**			**100%**	**-1.4[-10.9,8.1]**



Study or subgroup	Strapping		No Strapping		Mean Difference	Weight	Mean Difference
	N	Mean(SD)	N	Mean(SD)	Fixed, 95% CI		Fixed, 95% CI
Heterogeneity: Not applicable							
Test for overall effect: Z=0.29(P=0.77)							
				Favours No Strapping	-100 -50 0 50 100	Favours Strapping	

ADDITIONAL TABLES

Table 1. Methodological quality of included studies

Study	Score	Randomisation	Concealment	Baseline compatible	Assessor Blinding	Drop-outs = or < 15%	Intention to treat	Group comparisons	Point measures
Prevention trials									
Ancliffe 1992	3/8	No, alternate allocation	No	No, unknown	Yes	Yes, 0%	No, unknown	Yes	Yes
Griffin 2003	8/8	Yes	Yes, opaque envelope	Yes	Yes	Yes, 3%	Yes	Yes	Yes
Hanger 2000	8/8	Yes	Yes, opaque envelope	Yes	Yes	Yes, 15%	Yes	Yes	Yes
Hurd 1974	2/8	No, alternate allocation	No, unknown	No, unknown	No, unknown	Yes, 0%	No, unknown	No	Yes

APPENDICES

Appendix 1. MEDLINE/CENTRAL search strategy

MEDLINE (OVID) 1966 to March 2004 and the Cochrane Central Register of Controlled Trials (CENTRAL) 2004 issue 1, employing the search strategy:

1. exp cerebrovascular disorders/
2. (stroke$ or cerebrovascular or cerebral vascular or cva$).tw.
3. (cerebral or cerebellar or brain$ or vertebrobasilar).tw.
4. (infarct$ or isch?emi$ or thrombo$ or emboli$ or apoplexy).tw.
5. 3 and 4
6. (cerebral or brain$ or subarachnoid).tw.
7. (haemorrhage or hemorrhage or haematoma or hematoma or bleeding).tw.
8. 6 and 7
9. hemiplegia/
10. (hemipleg$ or hemipar$ or poststroke or post-stroke).tw.
11. 1 or 2 or 5 or 8 or 9 or 10
12. exp Orthotic Devices/
13. Splints/
14. (orthos$ or orthot$ or splint$ or sling$ or support$).tw.
15. (lapboard$ or lap board or laptray$ or lap tray$ or arm trough$).tw.
16. 12 or 13 or 14 or 15
17. shoulder dislocation/
18. shoulder/ or shoulder joint/ or shoulder pain/
19. (shoulder adj10 (sublux$ or dislocat$ or displace$ or malalign$ or misalign$)).tw.
20. 17 or 18 or 19
21. 11 and 16 and 20

Appendix 2. CINAHL search strategy

CINAHL (OVID) 1982 to March 2004, employing the search strategy:

1. exp cerebrovascular disorders/
2. (stroke$ or cerebrovascular or cerebral vascular or cva$).tw.
3. (cerebral or cerebellar or brain$ or vertebrobasilar).tw.
4. (infarct$ or isch?emi$ or thrombo$ or emboli$ or apoplexy).tw.
5. 3 and 4
6. (cerebral or intracerebral or intracranial or parenchymal or brain$ or intraventricular or periventricular or cerebellar or infratentorial or supratentorial or subarachnoid).tw.
7. (Haemorrhage or hemorrhage or haematoma or hematoma or bleed$ or aneurysm).tw.
8. 6 and 7
9. hemiplegia/
10. (aphasi$ or dysphasi$ or hemipleg$ or hemipar$).tw.
11. (hemipleg$ or hemipar$ or poststroke or post-stroke).tw.
12. 1 or 2 or 5 or 8 or 9 or 10 or 11
13. exp Orthotic Devices/
14. Splints/
15. (orthos$ or orthot$ or splint$ or sling$ or support$).tw.
16. (lapboard$ or lap board or laptray$ or lap tray$ or arm trough$).tw.
17. 13 or 14 or 15 or 16
18. shoulder dislocation/
19. shoulder/ or shoulder joint/ or shoulder pain/
20. (shoulder adj10 (sublux$ or dislocat$ or displace$ or malalign$ or misalign$)).tw.
21. 18 or 19 or 20
22. 12 and 17 and 21

Appendix 3. AMED search strategy

AMED 1985 to March 2004, employing the search strategy:

1. cerebrovascular disorders/
2. Hemiplegia/

3. (stroke$ or poststroke or post-stroke or cva$).tw.
4. (cerebrovascular or cerebral vascular or brain attack).tw.
5. (cerebral or cerebellar or brain$ or vertebrobasilar).tw.
6. (infarct$ or ischaemi$ or ischem$ or thrombo$ or apoplexy or emboli$ or insufficiency or occlusion).tw.
7. 5 and 6
8. (cerebral or intracerebral or intracranial or parenchymal or brain$ or intraventricular or cerebellar or infratentorial or supratentorial or subarachnoid).tw.
9. (haemorrhage or hemorrhage or haematoma or hematoma or bleed$ or aneurysm$ or vasospasm).tw.
10. 8 and 9
11. 1 or 2 or 3 or 4 or 7 or 10
12. exp Orthotic Devices/
13. Splints/
14. (orthos$ or orthot$ or splint$ or sling$ or support$).tw.
15. (lapboard$ or lap board or laptray$ or lap tray$ or arm trough$).tw.
16. 12 or 13 or 14 or 15
17. shoulder dislocation/
18. shoulder/ or shoulder joint/ or shoulder pain/
19. (shoulder adj10 (sublux$ or dislocat$ or displace$ or malalign$ or misalign$)).tw.
20. 17 or 18 or 19
21. 11 and 16 and 20

Appendix 4. EMBASE search strategy

EMBASE (ScienceDirect) 1974 to March 2004, employing the search strategy:

1. exp cerebrovascular disease
2. (stroke or poststroke or post stroke)
3. cerebrovascular
4. (cerebral or cerebellar or brainstem or vertebrobasilar)
5. (infarct! or ischemi! or thombo! or emboli!)
6. 4 and 5
7. (cerebral or intracerebral or intracranial or parenchymal or brain or intraventricular or brainstem or cerebellar or infratentorial or supratentorial or subarachnoid)
8. (haemorrhage or hemorrhage or haematoma or hematoma or bleeding or aneurysm)
9. 7 and 8
10. (hemiplegia or hemiparesis or hemipleg! or hemipar!)
11. 1 or 2 or 3 or 6 or 9 or 10
12. orthotic device
13. splint
14. (orthosis or orthotic or sling or support)
15. (lapboard or lap board or laptray or lap tray or arm trough)
16. 12 or 13 or 14 or 15
17. shoulder dislocation
18. (shoulder or shoulder joint or shoulder pain)
19. (shoulder subluxation or shoulder dislocation or shoulder displacement or shoulder malalignment or shoulder misalignment)
20. 17 or 18 or 19
21. 11 and 16 and 20

WHAT'S NEW

Date	Event	Description
3 October 2008	Amended	Converted to new review format.

CONTRIBUTIONS OF AUTHORS

Louise Ada (LA) contributed to the conception, design and approved the final manuscript of the protocol, helped extract trial and outcome data, guided the analysis and the interpretation of the data, contrituted to and approved the final manuscript of the review.

Anchalee Foongchomcheay (AF) contributed to the conception, design, drafted the protocol and searched electronic database and conference proceedings, screened titles and abstracts of references from the search, located, selected and assessed trials, extracted trials and outcome data, assessed the methodological quality of selected trials, contacted correspondents about unpublished data and also entered the data, carried out statistical analysis, helped with the interpretation of the data, drafted the review and approved the final manuscript of the review.

Colleen Canning (CC) contributed to screening the titles and abstracts of references from the search, located, selected and assessed trials, extracted trials and outcome data, assessed the methodological quality of selected trials, contributed to the interpretation of the data and contributed to and approved the final manuscript of the review.

DECLARATIONS OF INTEREST

None known

INDEX TERMS

Medical Subject Headings (MeSH)

*Orthotic Devices; Braces; Contracture [etiology] [prevention & control]; Randomized Controlled Trials as Topic; Shoulder Dislocation [*prevention & control]; Shoulder Pain [prevention & control]; Stroke [*complications]; Wheelchairs

MeSH check words

Humans